Evaluation of Air Toxics Data to Assess Air Quality Orange County, FL

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Overview of Presentation

- Introduction
- Policy-Relevant Questions/Methodology
- Results
- Summary/Conclusions

Orange County

- One of four counties in the Orlando MSA (> 1 million people)
- Prime destination for vacations (30 million annually)

- OCEPD
  - Created in 1968
  - Community and Environmental Services Department
  - www.orangecountyfl.net/cms/DEPT/CEsrvcs/epd/default.htm
- ERG is currently supporting carbonyl measurements under the UATMP for one site in Orange County (12-095-2002).

Policy-Relevant Questions

- What are typical pollutant concentrations in Orange County?
- Which pollutants contribute the greatest risk in Orange County on a short-term, intermediate-term, and chronic basis?
- What anthropogenic emission sources contribute to Orange County air quality?
- What is the role of meteorology on air quality in Orange County?

Methodology - Pollutants Coverage

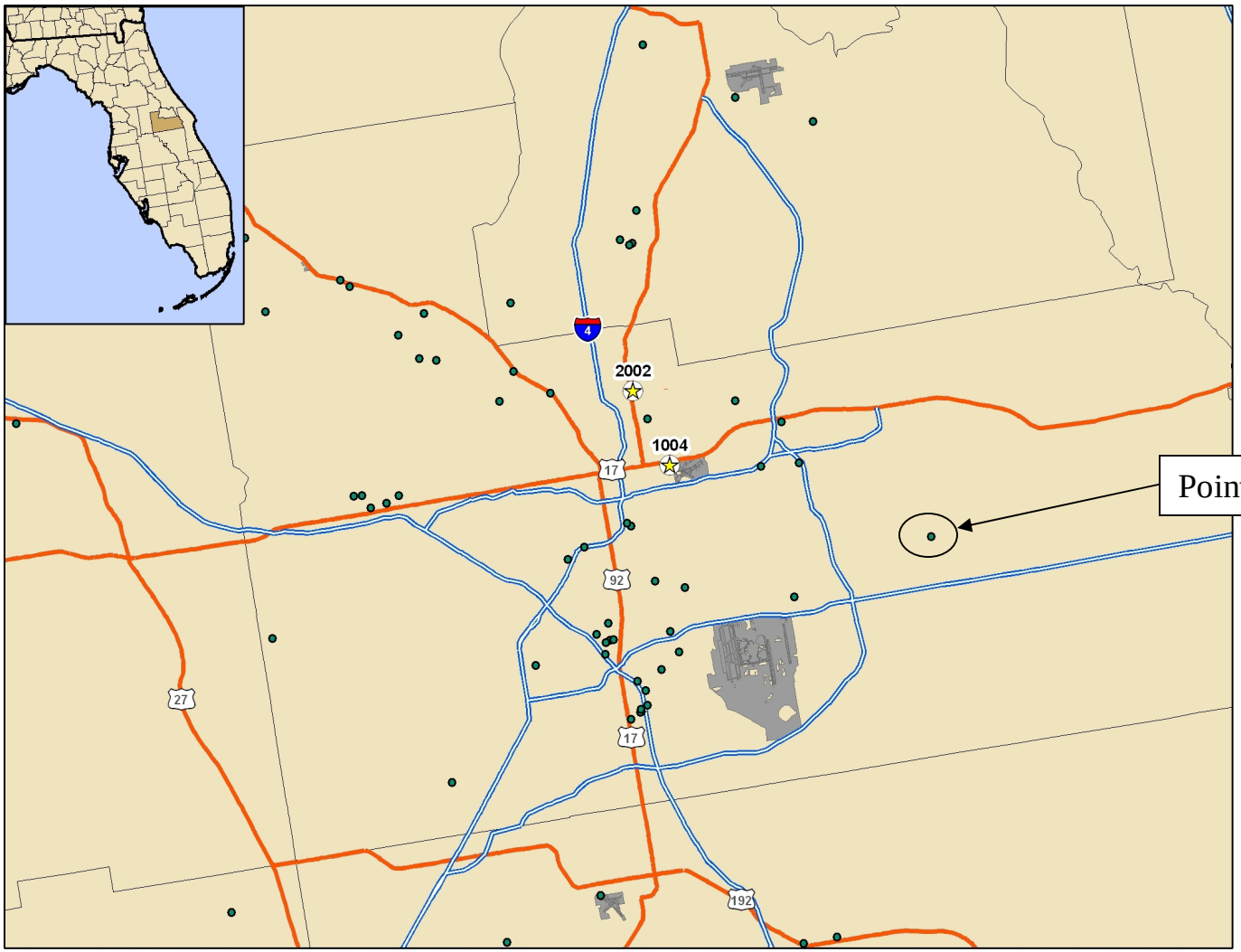
	VOCs	Carbonyls	Metals
Method	TO-15	TO-11A	IO-3.5
# Pollutants	59	11	12
# HAPs	38	3	11

- 82 pollutants
- 52 HAPs

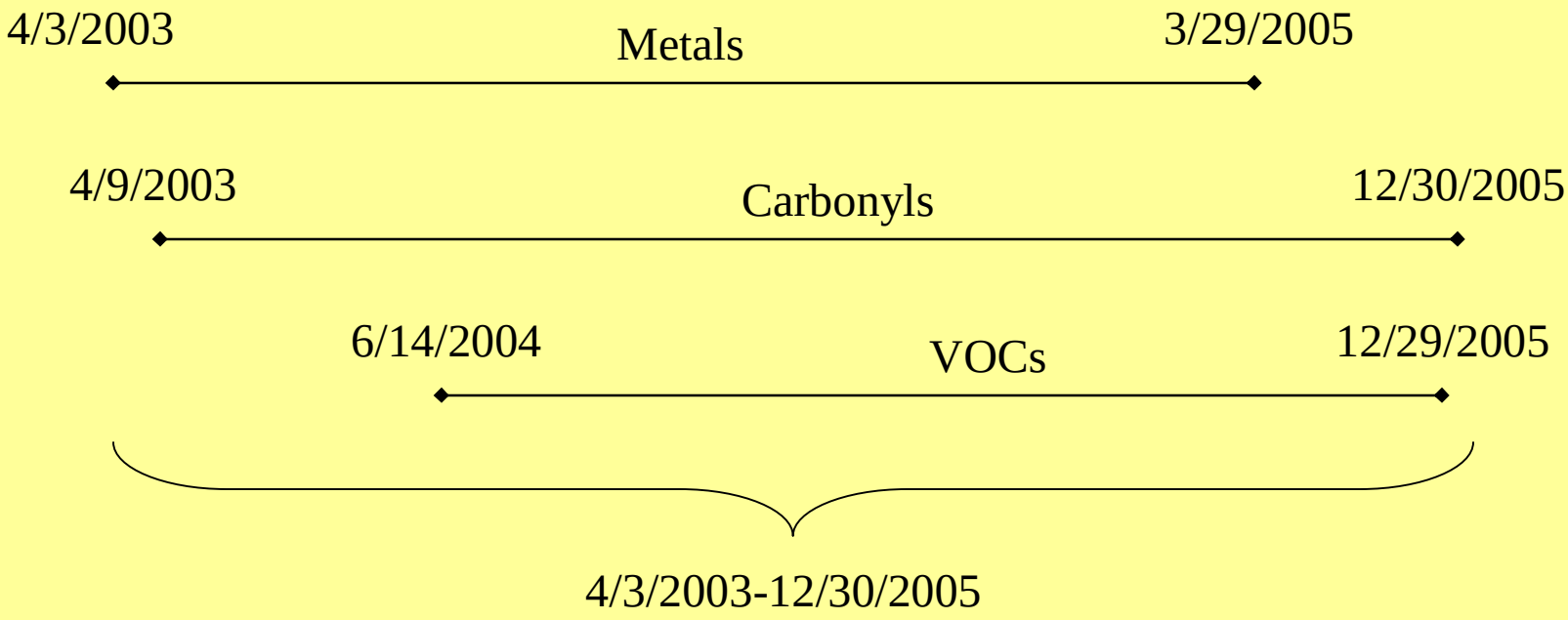
Methodology - Sites of Interest

AQS ID	Air Toxics	Criteria Pollutants	Land Use	Location Setting	Daily Traffic
12-095-0004		X	Residential	Rural	500
12-095-0008		X	Residential	Suburban	36,000
12-095-1004	X	X	Commercial	Suburban	60,000
12-095-1005		X	Commercial	Urban/ City Center	55,000
12-095-2002	X	X	Commercial	Urban/ City Center	59,000

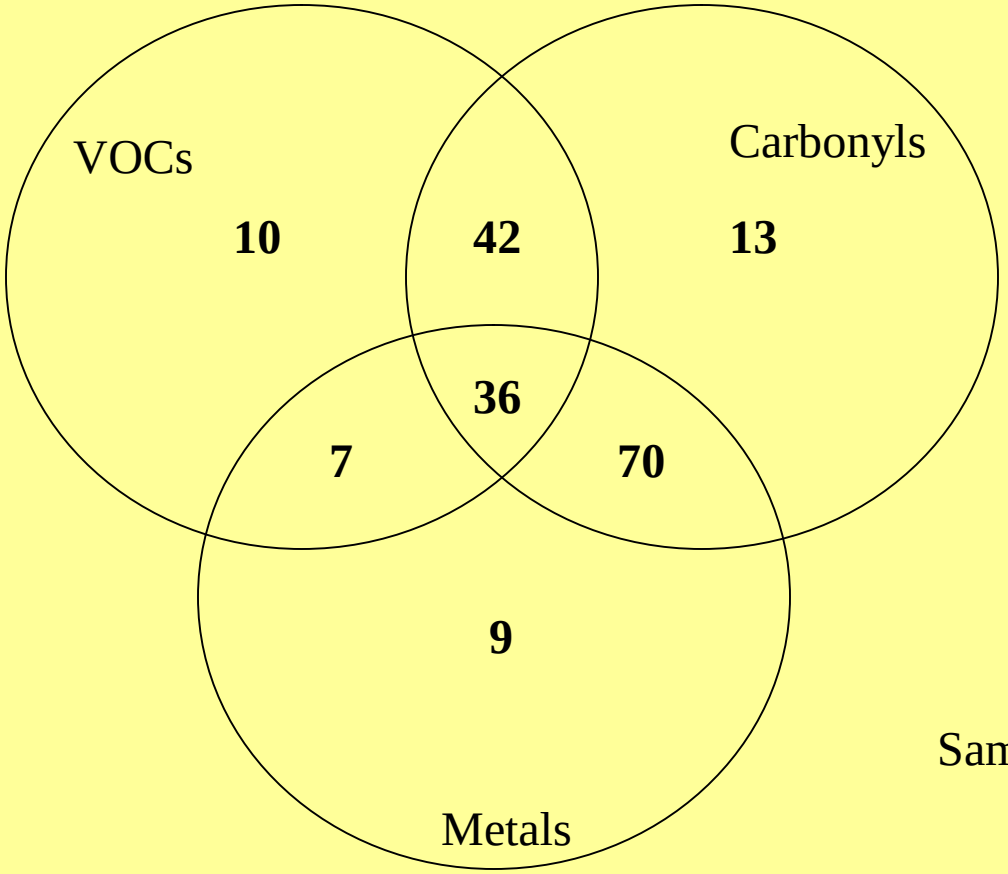
Methodology - Sites of Interest



Methodology - Time Period of Interest



Sampling Days



Sampling Days = 187

Database Compilation

- Relational database using Microsoft Access

- Ambient monitoring data sources:
  - Metals: OCEPD
  - VOCs: EPA's Air Quality Subsystem (AQS)
  - Carbonyls: AQS (under UATMP)
  - Criteria Pollutants: AQS

- Emissions data: 2002 National Emissions Inventory (NEI)
  - Stationary (point and area nonpoint)
  - Mobile (onroad and nonroad)

Database Compilation

- Meteorological data sources:
  - National Weather Service: hourly surface observations
  - HYSPLIT back trajectory data from NOAA
- National-scale Air Toxics Assessment (NATA) data
  - 1999 census tract modeled concentration data
  - HAPs only
- EPA's Air Toxics Website – MACT information

Results – typical concentrations?

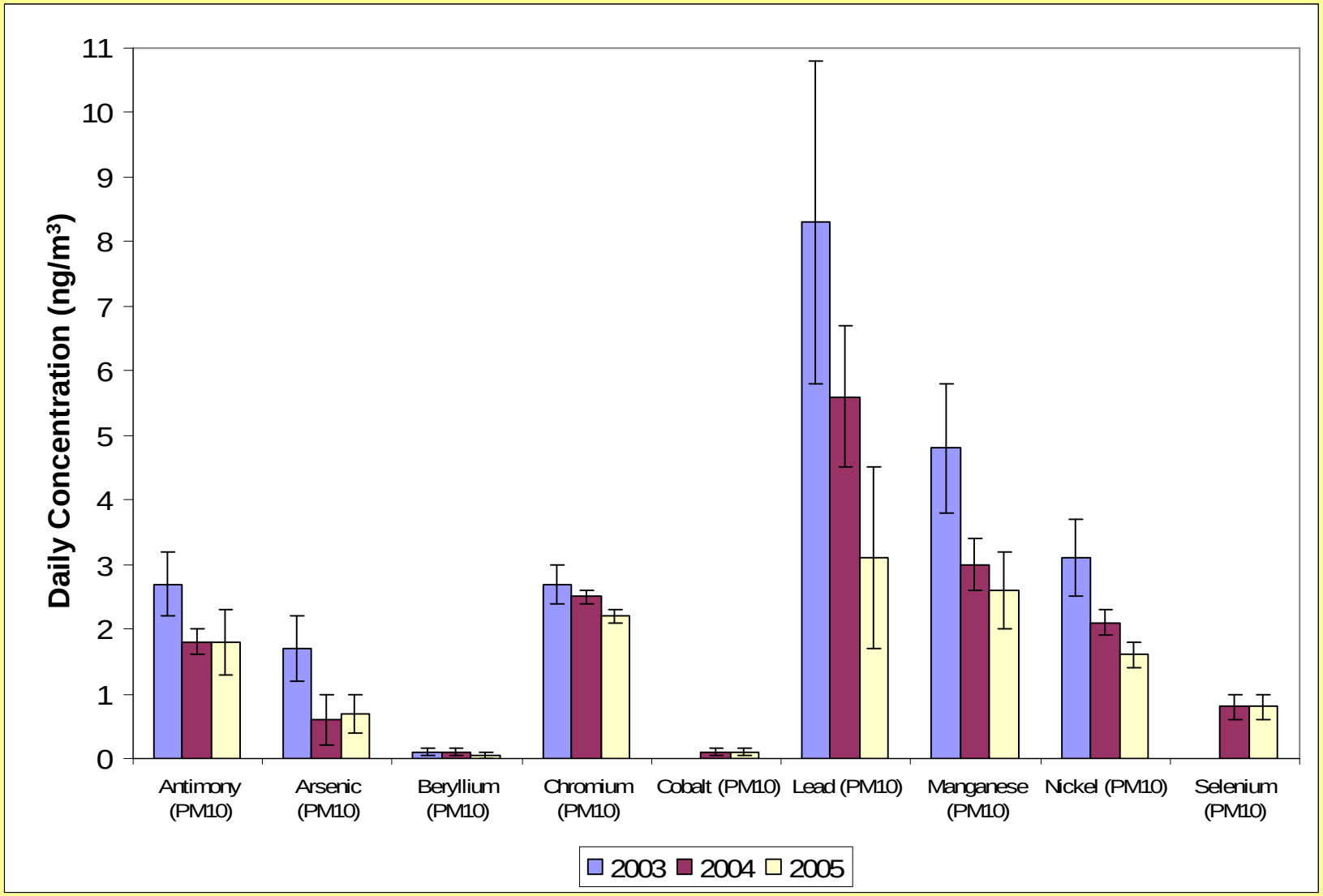
- Daily average:
  - Average concentration of all detects
  - Valid average = 75% detects

- Seasonal average:
  - Seasons: Winter (Dec.-Feb.); Spring (Mar.-May); Summer (Jun.-Aug.); Fall (Sep.-Nov.)
  - Minimum of 7 detects within a season
  - Substitute zeroes for non-detects
  - Average of all detects and zero-replaced non-detects

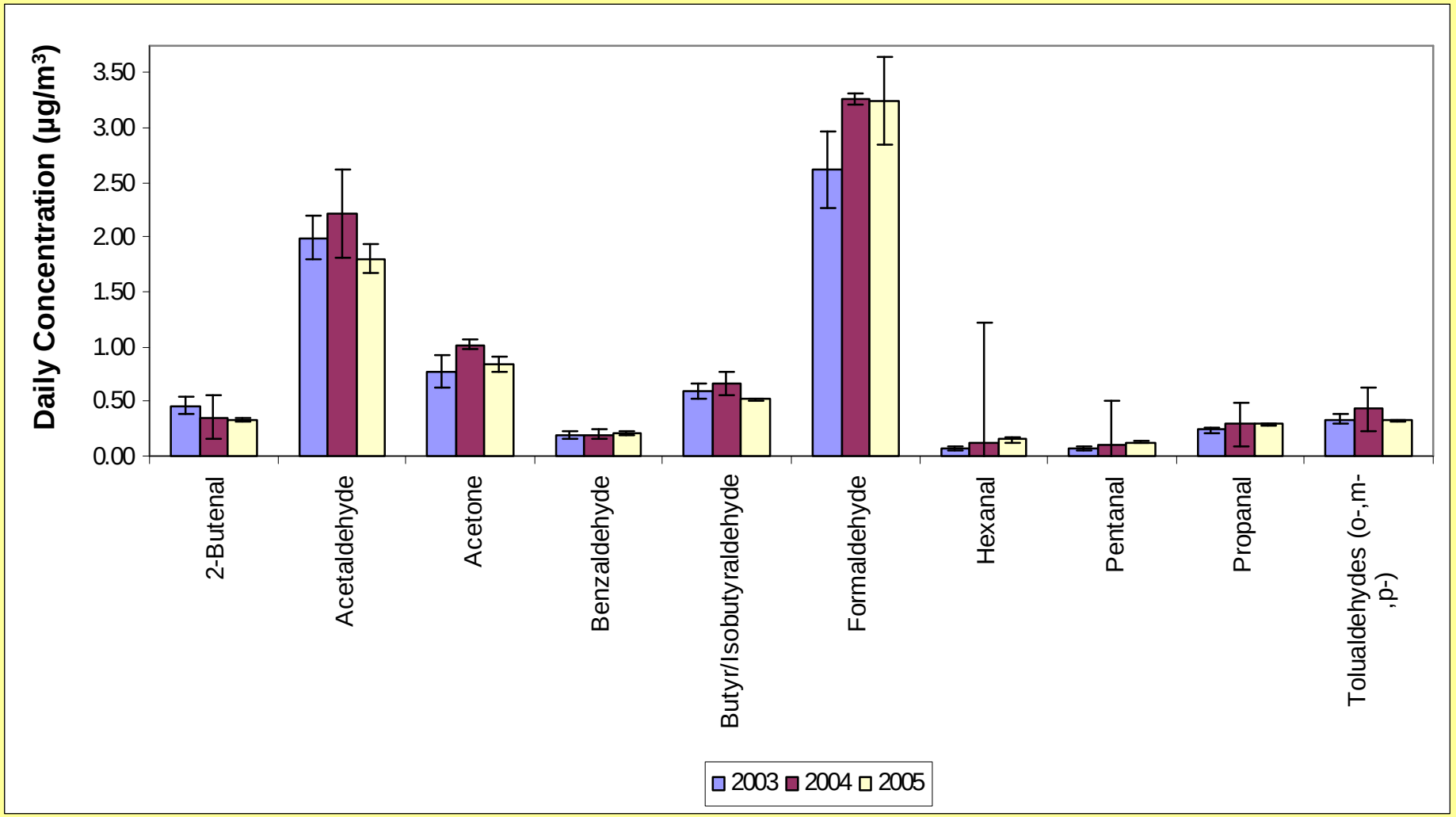
Results – typical concentrations?

- Annual average:
  - Sampling must begin no later than February and end no earlier than November
  - Substitute zeroes for non-detects
  - Average of all detects and zero-replaced non-detects

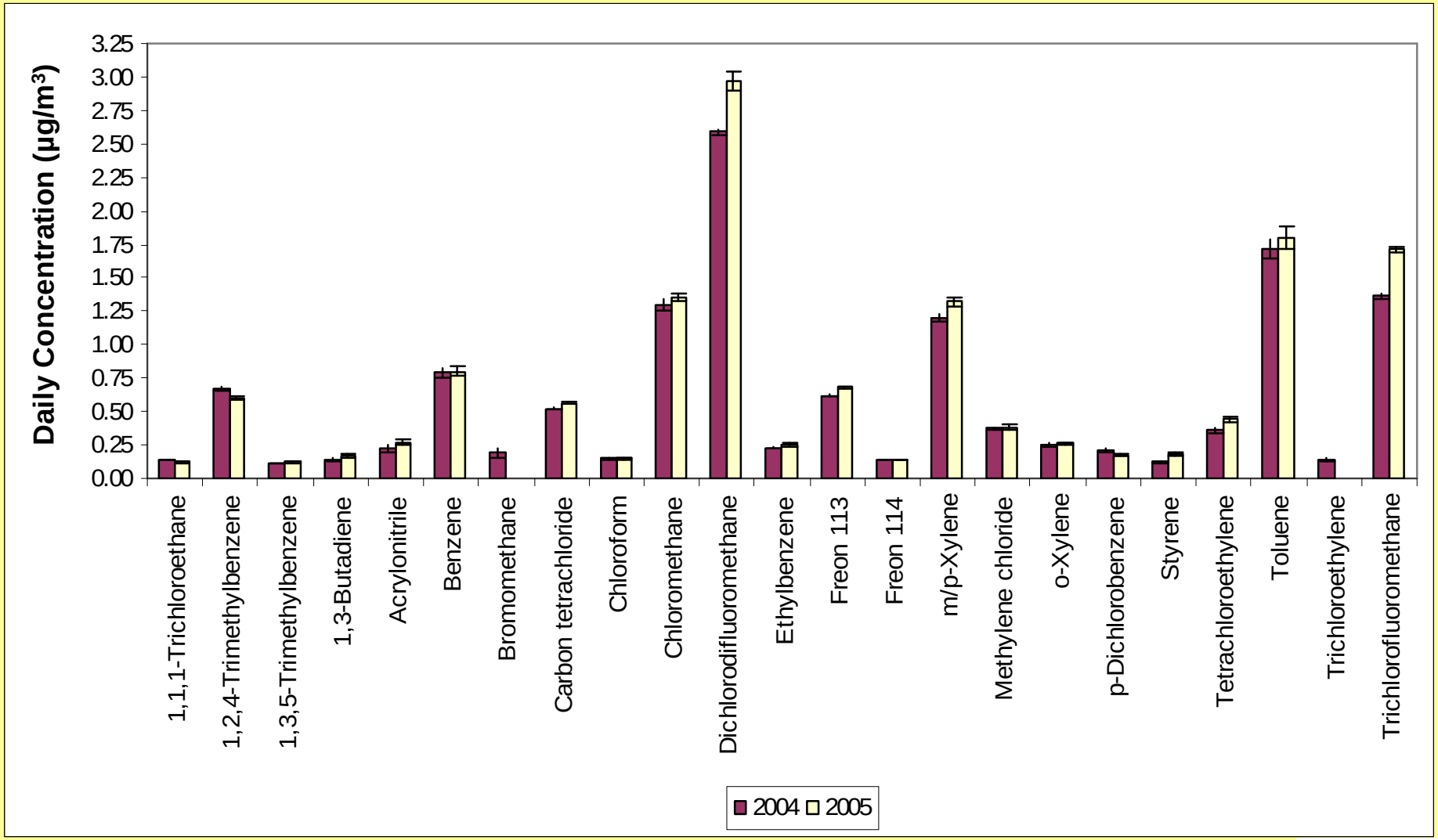
Results: Metals – daily average



Results: Carbonyls – daily average



Results: VOCs – daily average



Results - Evaluating Risk

- Risk Screening: Guidance from EPA Region 4 document:
  "A Preliminary Risk-Based Screening Approach for Air Toxics"

- Acute Risk: compare ATSDR and CALEPA acute risk factors against daily measurements

- Intermediate Risk: compare ATSDR and CALEPA intermediate-term risk factors against seasonal averages

- Chronic Risk:
  - Compared annual average concentrations with 1999 NATA modeled concentrations
  - Computed EPA cancer and noncancer risk using URE and RfC factors

Results – Risk Screening

- Methodology used in the 2005 UATMP Report. Modification of EPA Region 4 Risk Screening Guidance document
- Daily concentrations were compared to a risk screening factor
- If a concentration was greater than its risk screening factor, then the concentration "failed the screen"
- A total of 967 of 1,872 applicable concentrations (51.66%) failed their screens.

Results – Risk Screening

The pollutants contributing to the Top 95% of the total failed screens were identified as Pollutants Of Interest:

- Acetaldehyde (155 failed screens)*
- Acrylonitrile (69)
- Arsenic (63)
- Benzene (69)*
- 1,3-Butadiene (69)*
- Carbon tetrachloride (69)*
- Chromium (115)
- *p*-Dichlorobenzene (67)
- Formaldehyde (153)
- Nickel (56)
- Tetrachloroethylene (46)

* Pollutant failed 100% of its screen

Results – Non-chronic Risk

- No single concentration exceeded its acute risk factor
- No seasonal concentration exceeded its intermediate-term risk factor
- However, acrolein was a pollutant not reported under TO-15. This pollutant often exceeded these risk factors in the 2005 UATMP.

Results – Chronic Risk, NATA

- Orange County 1999 NATA Risk:
  - Cancer risk (all HAPs) = 43.7 in-a-million (rank 137)
  - Respiratory noncancer risk = 9.37 (rank 52)
  - Primary emission sources contributing to risk are mobile onroad sources and background sources

- Census tract with greatest cancer risk (80.3 in-a-million) does not contain an air toxics monitor.

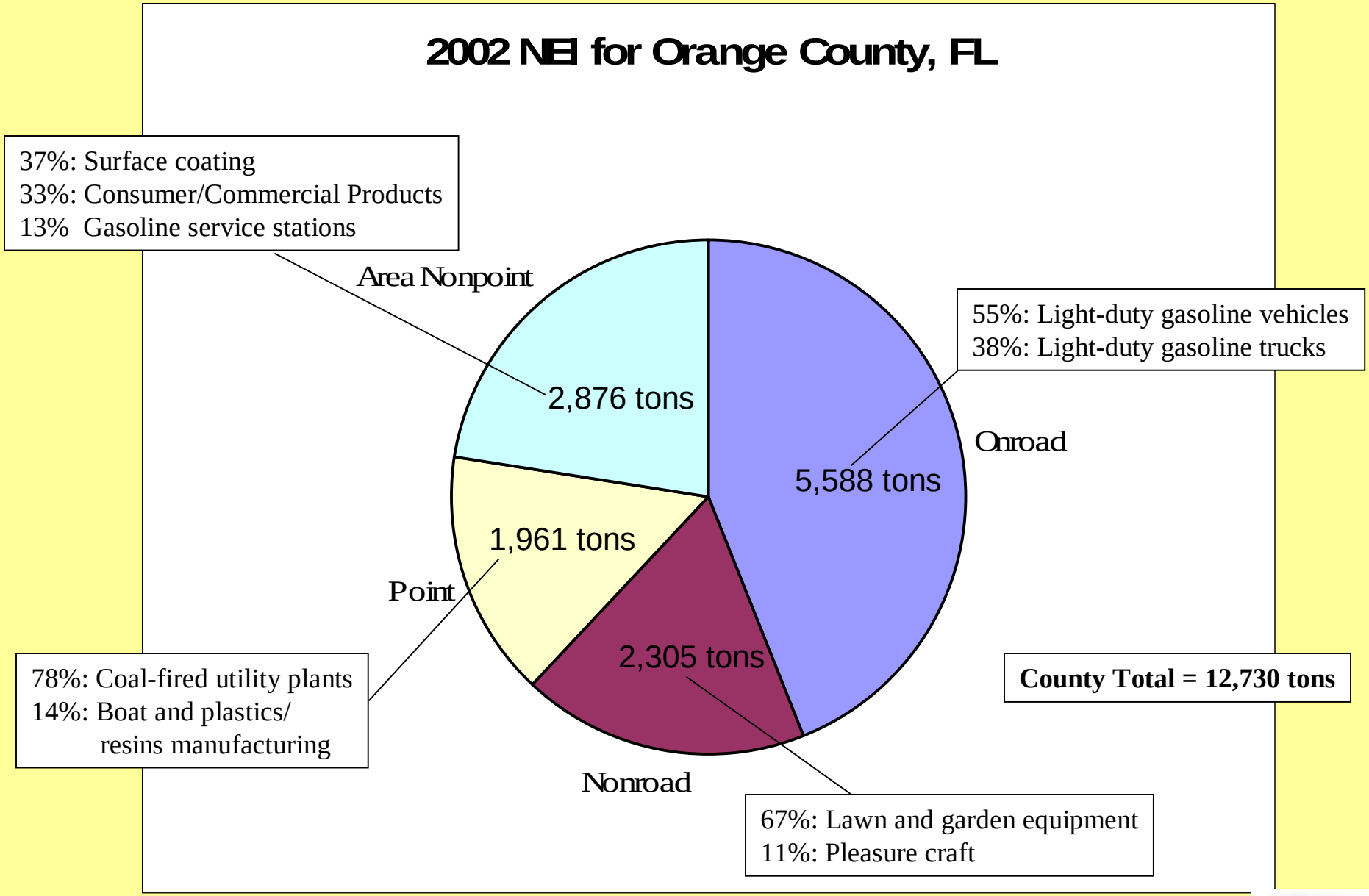
- The majority of 1999 NATA-modeled concentrations were within an order of magnitude of the study's annual average concentrations

Results – Chronic Risk, NATA

1999 NATA Modeled Conc.	Annual Average Conc.
1. Toluene (5.50 µg/m^3)	1. Formaldehyde (3.25 µg/m^3)
2. Xylenes (3.55 µg/m^3)	2. Acetaldehyde (2.00 µg/m^3)
3. Benzene (2.26 µg/m^3)	3. Toluene (1.80 µg/m^3)
4. Acetaldehyde (1.99 µg/m^3)	4. Xylenes (1.58 µg/m^3)
5. Formaldehyde (1.99 µg/m^3)	5. Chloromethane (1.35 µg/m^3)

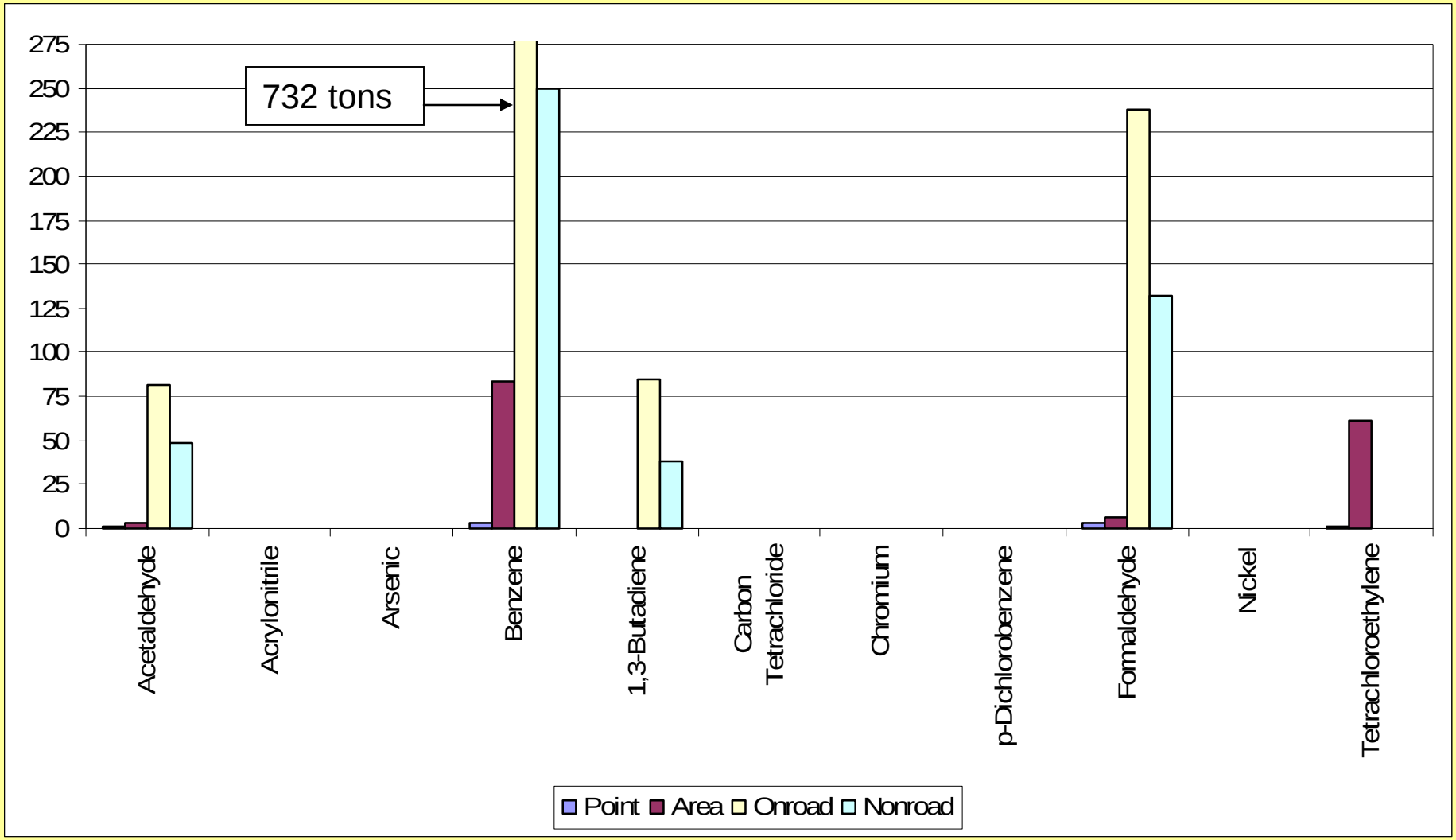
- Possible under-estimation of acrylonitrile concentration
  - Calculated cancer risk = 18.36 in-a-million (highest)
  - Annual average concentration = 0.27 µg/m^3
  - NATA modeled concentration = 0.00047 µg/m^3
- Highest calculated noncancer HQ = 0.33 (formaldehyde)

Results – Emission Sources



Results – Emission Sources

Pollutants of Interest



Results – Concentration vs. Emissions

Pollutant	Study Average Concentration (µg/m^3)	Concentration Rank	Total Emissions (tons)	Emissions Rank
Formaldehyde	3.07	1	380	5
Acetaldehyde	1.99	2	134	8
Toluene	1.76	3	2,885	1
Xylenes (total)	1.52	4	1,960	2
Chloromethane	1.33	5	0.7	16

- Benzene
  - Emissions rank = 3rd (1,069 tpy)
  - Concentration rank = 6th (0.79 µg/m^3)

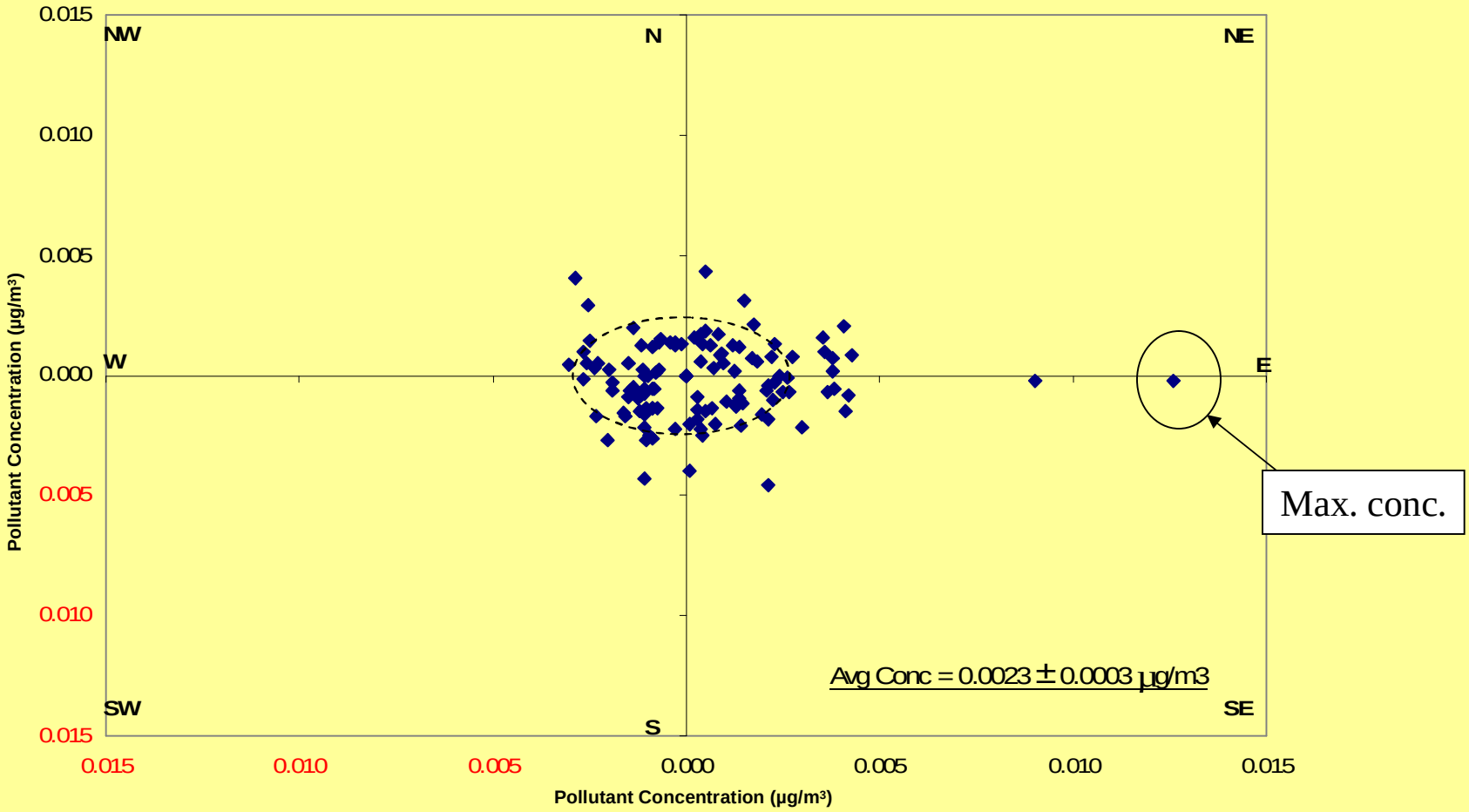
- Ethylbenzene
  - Emissions rank = 4th (472 tpy)
  - Concentration rank = 12th (0.24 µg/m^3)

Results – Role of Meteorology

- Case Study: Nickel Concentrations

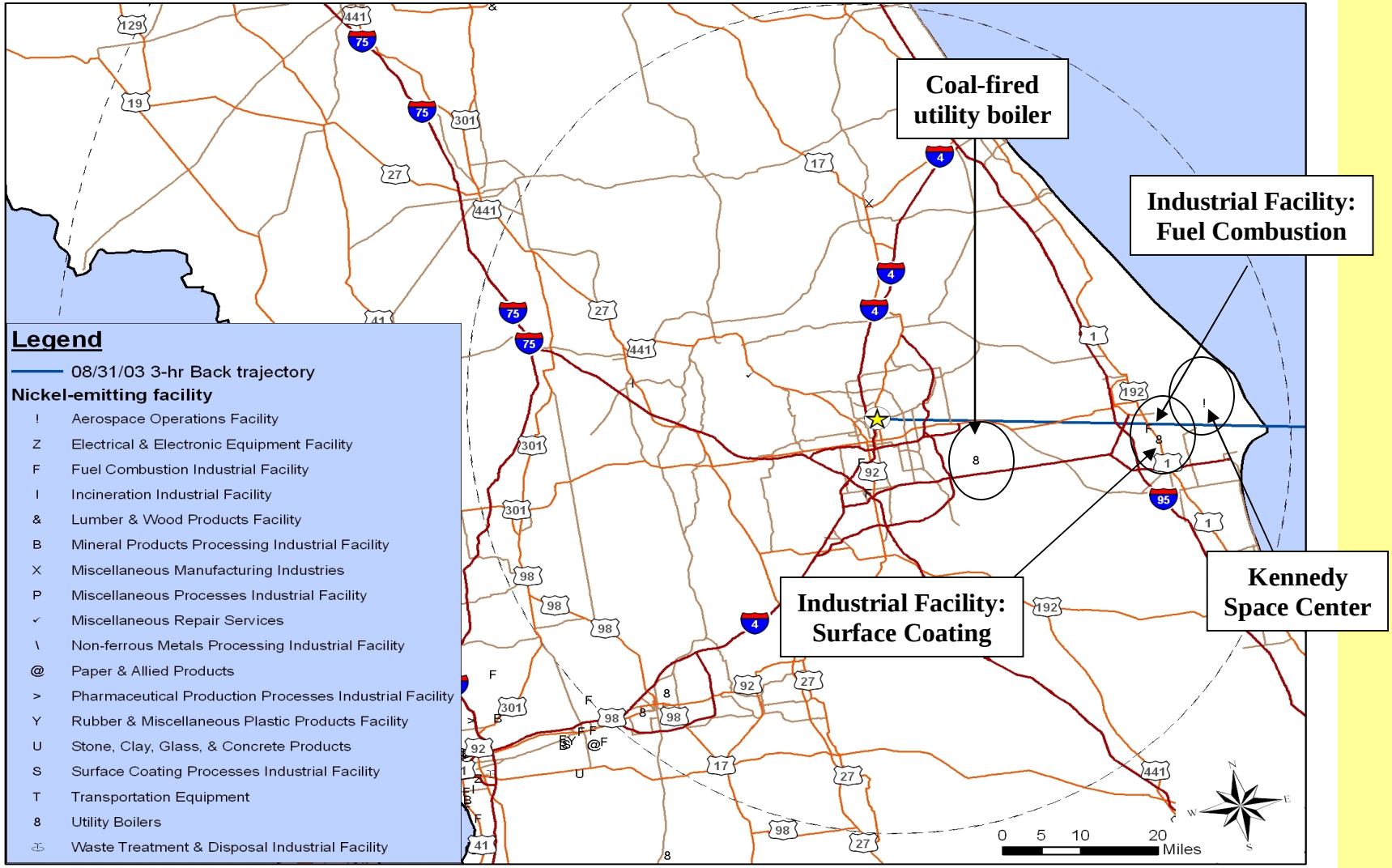
Statistic	**Value (ng/m^3)**
Risk Screening Value	2.1
Ave. Daily Conc.	2.3 ± 0.3
Max. Conc.	12.6
Orange County Emissions	0.5 tons

Results – Pollution Rose



Nickel Pollution Rose

Results – Back Trajectory



Summary/Conclusions

What are typical pollutant concentrations in Orange County?

By mass concentration, Top 3 Daily Averages:

- Metals: lead, manganese, and nickel
- VOCs: dichlorofluoromethane, toluene, and chloromethane
- Carbonyls: formaldehyde, acetaldehyde, and acetone

Summary/Conclusions

Which pollutants contribute the greatest risk in Orange County on a short-term, intermediate-term, and chronic basis?

- Eleven pollutants were identified as a pollutant of interest using a risk screening methodology
- No short-term or intermediate-term risk factors were exceeded (however, acrolein was not reported)
- Most pollutant annual average concentrations were within an order of magnitude to the NATA modeled concentrations
  - Highest calculated cancer risk = 18.36 in-a-million (acrylonitrile)
  - Highest calculated noncancer HQ = 0.33 (formaldehyde)

Summary/Conclusions

What anthropogenic emission sources contribute to Orange County air quality?

- Mobile onroad HAP emissions are the highest component in the county, with light-duty gasoline vehicles as the highest source category

- The presence of several coal-fired utility boilers and boat and plastics/resins manufacturing facilities are the largest point sources in the county

Summary/Conclusions

What is the role of meteorology on air quality in Orange County?

- A case study for the maximum nickel concentration was presented
  - Typical concentrations were about 2 ng/m^3
  - The maximum concentration (12.6 ng/m^3) occurred on 8/31/03 (> six times than typical concentration)
  - The pollution rose for nickel showed highest concentrations when the wind was from the east of Orange County
  - A back trajectory for 8/31/03 was overlaid onto a nickel emissions source map. It appears as if the air passed by several nickel emission sources prior to reaching Orange County.

Questions?

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